Remarks:

The above amendments and these remarks are responsive to the non-final Office action dated January 24, 2007, and are being filed under 37 C.F.R. § 1.111. Claims 1-9, 11, 12, and 14–20 are pending in the application. In the Office action, the Examiner rejected each of the pending claims under 35 U.S.C. § 102 or § 103 as being anticipated by or obvious over one or more references. Applicants traverse the rejections, contending that all of the pending claims are patentable over the cited references.

Nevertheless, to expedite the issuance of a patent, and to more particularly point out and distinctly claim the subject matter that applicants would like to patent now, applicants have (1) amended independent claims 12 and 17, and (2) added new dependent claims 41 and 42. However, applicants reserve the right to pursue the previously presented subject matter of either or both of the amended claims at a later time. Furthermore, applicants have presented remarks showing that all of the pending claims are patentable over the cited references. In view of the amendments above, and the remarks below, applicants respectfully request reconsideration of the application under 37 C.F.R. § 1.111 and prompt allowance of all the pending claims.

I. ***Claim Rejections – 35 U.S.C. § 102***

In the Office action, the Examiner rejected claims 17–20 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,838,056 to Foster ("Foster"). Applicants traverse the rejections, contending that Foster does not teach or suggest every element of any of claims 17–20. Nevertheless, applicants have amended

independent claim 17 to clarify the differences between Foster and the claimed invention.

Claim 17, as amended, reads as follows:

> 17. (Currently Amended) A device for sorting particles, comprising:
>
> a channel structure defining first and second channels that extend adjacent one another and between respective pairs of opposing ends of the first and second channels, the channel structure further defining a transverse channel that connects the first channel to the second channel intermediate the pair of opposing ends of each channel;
>
> a first transport mechanism configured to send respective first and second streams through the first and second channels, the first stream including first particles and one or more second particles; and
>
> a second transport mechanism configured to selectively move at least one of the second particles from the first stream **in the first channel** to the second stream **in the second channel** via the transverse channel.

Foster does not teach or suggest every element of amended claim 17. For example, Foster does not teach or suggest "a transverse channel that connects the first channel to the second channel intermediate the pair of opposing ends of each channel," and particularly not "a second transport mechanism configured to selectively move at least one of the second particles from the first stream in the first channel to the second stream in the second channel via the transverse channel."

Foster relates to a method and apparatus for sorting biological cells, particularly hematopoietic stem cells in blood. The apparatus is disclosed to include a MEMS cell sorter chip capable of sorting portions of an input blood sample in parallel. Figure 1 of Foster, which is reproduced here to facilitate review, illustrates a side view of the sorter chip.

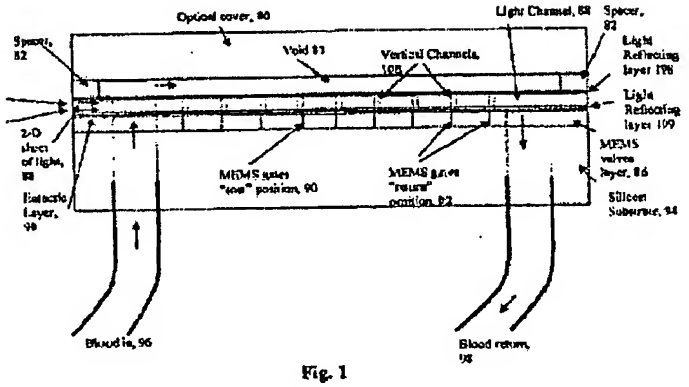


Fig. 1

Blood enters the sorter chip through inlet via 96 and exits the sorter chip, after removal of stem cells, through exit via 98. The blood enters void 83 from inlet via 96 and then is distributed among an array of vertical channels 108 in which cells can be illuminated and detected. Figure 2 of Foster, which is reproduced here to facilitate review, shows a top view of the cell sorter chip, particularly the array of vertical channels 108.

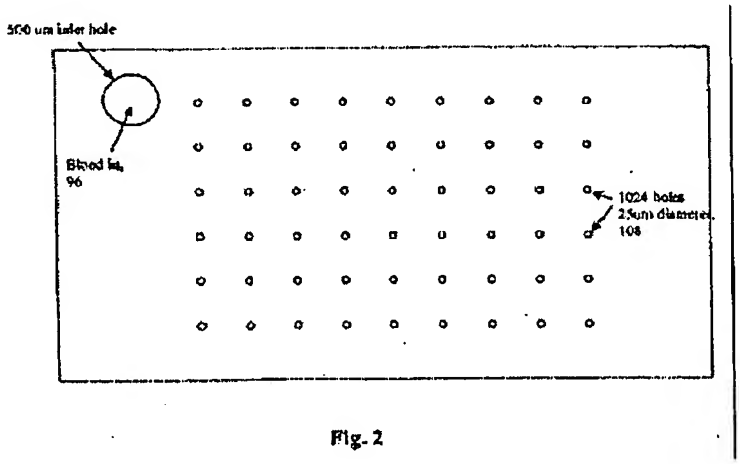


Fig. 2

Figure 3 of Foster, which is reproduced here to facilitate review, illustrates an actuator/manifold layer of the cell sorter chip.

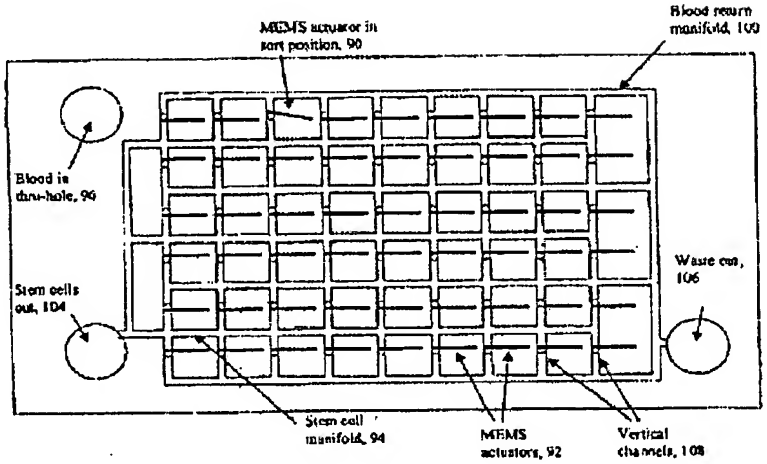


Fig. 3

The actuator/manifold layer is disposed at the *downstream ends* of vertical channels 108. The actuator/manifold layer provides MEMS actuators 90, 92 that sort cells as the cells *exit* the vertical channels, into either a stem cell manifold 94 or a blood return manifold 100 according to a detected property of each cell.

In the Office action, the Examiner suggested that vertical channels 108 correspond to the recited first and second channels of claim 17. However, claim 17 also recites "a transverse channel that connects the first channel to the second channel *intermediate* the pair of opposing ends of each channel." Vertical channels 108 of Foster are not connected by any kind of channel *intermediate* their opposing ends. Accordingly, the cell sorter chip disclosed by Foster does not provide "a second transport mechanism configured to selectively move at least one of the second particles from the first stream *in the first channel* to the second stream *in the second channel* via the transverse channel," as recited by amended claim 17. Therefore, independent claim

17 should be allowed. In addition, dependent claims 18–20 and 42, which depend from claim 17, also should be allowed for at least the same reasons as claim 17.

Dependent claims 18–20 and 42 further distinguish the claimed invention of claim 17 from the disclosure of Foster. For example, new claim 42 recites "wherein the transverse channel provides the same path between the first and second channels whether or not the second transport mechanism is selectively moving a second particle." Support for claim 42 is included in the application, such as in Figure 6 and on page 12, line 19, to page 13, line 19. Foster, in contrast to claim 42, relies on MEMS actuators 90, 92 that function as valves, which selectively place an obstruction in one of the two alternative flow directions at the outlet of each vertical channel, to selectively alter the path between the channels. Foster thus does not disclose a transverse channel that provides the same path whether or not the second transport mechanism is selectively moving a second particle, as recited by claim 42. Accordingly, claim 42 also should be allowed for at least this additional reason.

II. Claim Rejections – 35 U.S.C. § 103

The Examiner rejected claims 1–9, 11, 12, and 14–16 as being obvious over a combination of references. Applicants traverse the rejections, contending that none of the rejected claims is obvious over the cited references. Nevertheless, for the reasons set forth above, applicants have amended independent claim 12. Support for the amendments to claim 12 are included in the application as filed, for example, in claims 2 and 3; on page 13, lines 24–30; and in Figure 7. Each of claims 1–9, 11, 12, 14–16, and new claim 41 is patentable for at least the reasons set forth below.

A. *Claims 1–9 and 11*

Independent claim 1, as previously presented, reads as follows:

> 1. (Previously Presented) A device for sorting particles, comprising:
>
> a channel structure defining a channel having an inlet and first and second outlets;
>
> a first transport mechanism configured to create a particle stream of first particles and one or more second particles, each particle traveling along the channel from the inlet toward the first outlet and disposed in a fluid supported by the channel structure; and
>
> a second transport mechanism configured to be pulse-activated to selectively move at least one of the second particles from the particle stream and toward the second outlet,
>
> wherein the channel structure defines a passage disposed in fluid communication with the channel and generally opposing the second outlet, and wherein the passage includes a fluid diode configured to restrict fluid backflow created by operation of the second transport mechanism.

In the Office action, claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. 2003/0027225 to Wada et al. ("Wada") in view of U.S. Patent No. 4,216,477 to Matsuda et al. ("Matsuda"). However, as set forth below, applicants submit that the Examiner has not established a *prima facie* case of obviousness because there is no teaching, suggestion, or motivation to combine the cited references to achieve the claimed invention.

Wada relates to microfluidic devices and systems for separating components of a mixture. In rejecting claim 1, the Examiner referred specifically to Figure 5A of Wada, which is reproduced here to facilitate review:

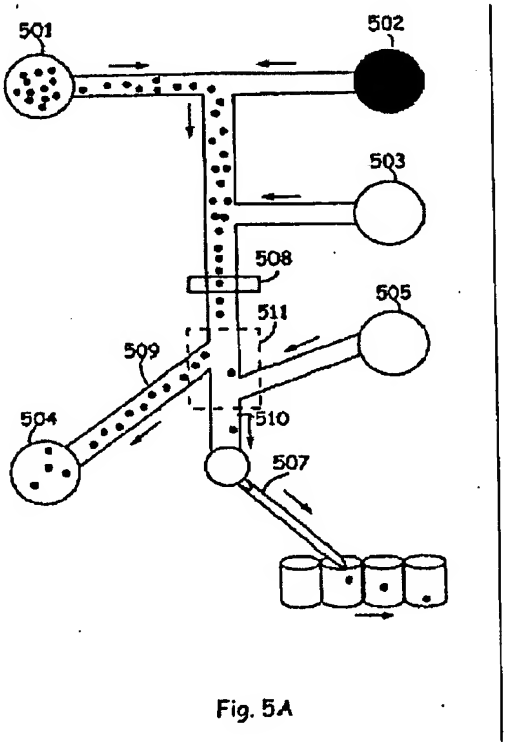


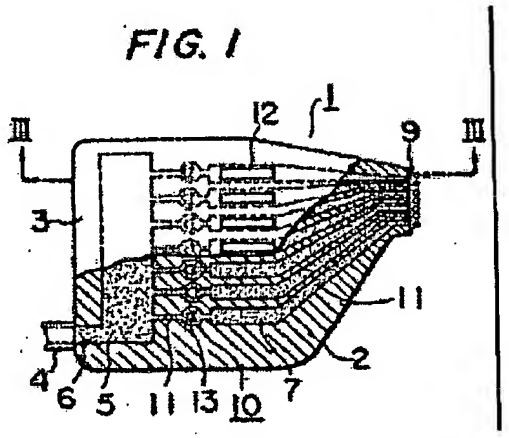
Fig. 5A

Figure 5A schematically illustrates cell sorting from a cell mixture using a device disclosed by Wada. A pressure controller of the device includes independent pumps connected to wells 501–505 and configured to control the pressure exerted by each well over a range of pressures. Cells from a cell mixture disposed in well 501 leave the well, travel along a channel to a switching intersection 511, and then follow one of two paths according to the current mode of the device. In a waste mode, cells travel into side channel 509, which leads to waste well 504. In a sorting mode, the pressure controller temporarily changes the pressure applied at wells 504 and 505 so that sorted cells

travel into channel region 510 and then capillary element 507. Accordingly, to promote rapid switching between the waste mode and the sorting mode, the relative pressures exerted by wells 504 and 505, and any changes in these relative pressures, should be transmitted efficiently to switching intersection 511. In other words, any structure (such as a fluid diode) that would have been expected to restrict transmission of pressure changes to the switching intersection also would have been expected to reduce sorting speed and efficiency.

Matsuda relates to a nozzle head of an inkjet printing apparatus having built-in fluid diodes. Figure 1 of Matsuda, which is reproduced here to facilitate review, illustrates an exemplary nozzle head with fluid diodes. The nozzle head has an ink reservoir 5 connected via flow paths 11 and pump chambers 7 to a plurality of nozzle holes 9 for ejecting ink particles. A fluid diode 10 for restricting reverse fluid flow is disposed between ink reservoir 5 and each pump chamber 7. Significantly, in Matsuda, the presence of fluid diodes makes sense because the fluid diodes are being used in a device structured for one-way fluid flow. In other words, ink flows from reservoir 5 to the nozzle holes, whereas reverse flow would have the tendency to destroy the ink delivering capability of the nozzle head by causing the nozzles to lose their primed condition.

FIG. 1



It would not have been obvious to combine Wada with Matsuda because there is no teaching, suggestion, or motivation to make this combination. In particular, neither Wada nor Matsuda suggests any reason to place a fluid diode into the device of Wada, because the device of Wada operates quite differently from the nozzle head disclosed by Matsuda and for very a different purpose. Furthermore, as described above in relation to Figure 5A, Wada discloses a sorting system that relies on rapid changes in pressure at switching intersection 511, in opposing directions, to rapidly switch between waste and sorting modes. A fluid diode of Matsuda, if placed into switching intersection 11 of Wada, would have been expected to disrupt the operation of the device of Wada. In particular, fluid would be restricted from flowing rapidly in opposing directions, thereby restricting the changes in pressure necessary for sorting. As a result, the maximum sorting speed of Wada's device would have been expected to be reduced by the fluid diode of Matsuda, making Wada's device less efficient. Accordingly, it would not have been obvious to modify Wada to include "a fluid diode configured to restrict fluid backflow created by operation of the second transport mechanism," as recited by claim 1.

In summary, it would not have been obvious to combine Wada with Matsuda to achieve the invention of independent claim 1. Claim 1 thus should be allowed. In addition, claims 2–9 and 11, which ultimately depend from claim 1, also should be allowed for at least the same reasons as claim 1. Specifically regarding claims 2 and 3, it is submitted that Foster does not supply the motivation to combine Wada with Matsuda, nor does Foster supply the deficiencies of these references; and specifically regarding claim 8, it is submitted that Miles (U.S. Patent No. 6,811,133) does not supply the motivation to combine Wada with Matsuda, nor does Miles supply the deficiencies of these references.

B. *Claims 12, 14–16, and 41*

Independent claim 12, as currently amended, reads as follows:

> 12. (Currently Amended) A device for sorting particles, comprising:
>
> **a substrate assembly including a substrate, a plurality of thin-film electrical devices formed on the substrate, and a fluid barrier connected to the substrate such that the substrate assembly defines** ~~a channel structure defining~~ a channel having an inlet and first and second outlets, **the channel and the thin-film electrical devices being disposed generally between the substrate and the fluid barrier**;
>
> a first transport mechanism configured to move first particles and one or more second particles in the channel from the inlet toward the first outlet, the first particles and one or more second particles being disposed in a fluid; and
>
> a second transport mechanism configured to apply a transient pressure pulse on the fluid so that at least one of the second particles is selectively moved toward the second outlet,
>
> wherein the second transport mechanism includes a thin-film heater element, a thin-film piezoelectric element, or **both, and wherein the thin-film heater, the thin-film piezoelectric element, or both are included in the thin-film electrical devices**.

In the Office action, claim 12 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,808,075 to Böhm et al. ("Böhm") in view of U.S. Patent No. 6,811,133 to Miles ("Miles"). However, as set forth below, applicants submit that the cited references, taken alone or in combination, do not teach or suggest every element of amended claim 12. For example, the cited references do not teach or suggest thin-film electrical devices "disposed generally between the substrate and the fluid barrier." Furthermore, the cited references do not teach or suggest a second transport mechanism including a thin-film heater or a thin-film piezoelectric element (or both) that 1) is included in the thin-film electrical devices and 2) has the recited disposition. Furthermore, applicants submit that it would not have been obvious to combine the references.

Böhm relates to a method and apparatus for sorting particles. Figure 1 of Böhm, which is reproduced here to facilitate review, illustrates an exemplary particle sorting system 10. A stream of particles is introduced by a first supply duct 12. The particles enter a measurement duct 16, which extends to a branch point 21 and first and second branches 22a, 22b. The particles are detected by a detector 19 as the particles flow through a measurement region 20. Chambers 70a, 70b are positioned in communication with the measurement duct via side passages 24. An *external* actuator 26 is operatively coupled to chamber 70b, to controllably impose a pressure differential between the chambers and thus between bubble valves 100a, 100b created by the chambers.

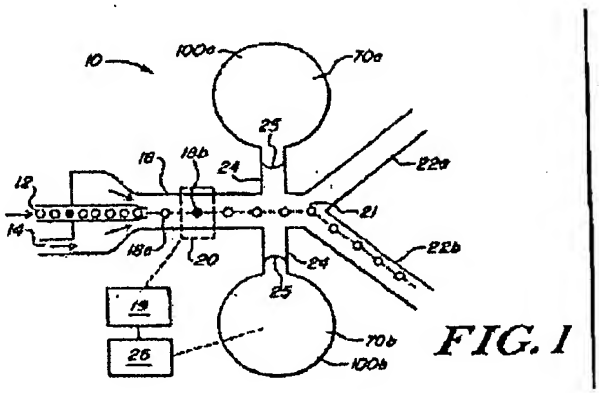


FIG. 1

Figure 7 of Böhm, which is reproduced here to facilitate review, presents a side view of an embodiment of a bubble valve 100 including an external actuator 26 that acts on compression chamber 70 of the bubble valve.

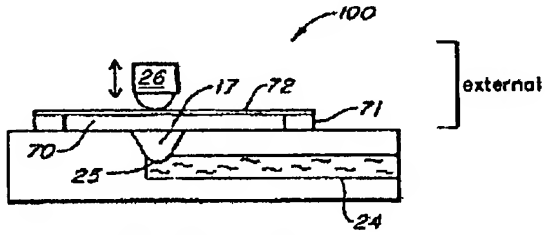


FIG. 7

However, external actuator 26 is not included in thin-film electrical devices that are disposed between a substrate and a fluid barrier, as recited by amended claim 12. Instead, the actuator is an external device disposed outside of passage 24, outside of the member that defines passage 24, and outside of compression chamber 70. Furthermore, the external device is disclosed to be a piezoelectric column or a heat pulse generator, among others, and not a thin-film electrical device.

The Examiner relied on Miles for disclosure of a piezoelectric thin-film electrical device. Miles relates to a hydraulically amplified PZT MEMS actuator. Figure 2 of Miles, which is reproduced here to facilitate review, illustrates an embodiment of an actuator system.

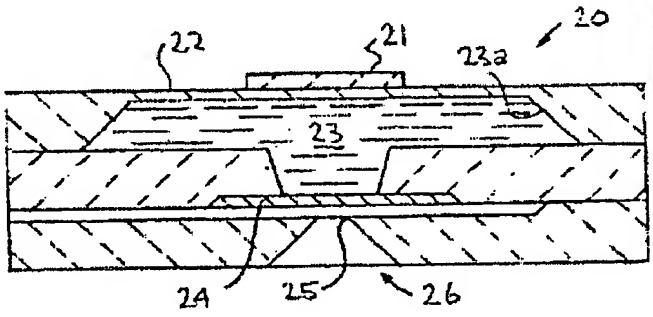


FIG. 2

The system of Figure 2 includes a piece 21 of piezoelectric material, which is bonded to or deposited as a thin film on a thin flexible diaphragm 22. Electrical energization of the piezoelectric material causes diaphragm 22 to bow into a reservoir 23 of relatively incompressible fluid 23a. As a result, fluid 23a pushes against second membrane 24 disposed opposite diaphragm 22, which urges second membrane 24 downward against a valve seat 25 to close a valve 26. Significantly, piece 21 of piezoelectric material is positioned opposite valve 26. Accordingly, neither Figure 2 nor Miles taken as a whole, teaches or suggests placement of the piezoelectric material between a substrate and a fluid barrier; and thus, it is submitted that Miles also does not teach or suggest "the channel and the thin-film electrical devices being disposed generally between the substrate and the fluid barrier," as recited by amended claim 12.

Furthermore, it would not have been obvious to combine the cited references. Miles does not teach or suggest the use of the disclosed actuator in a cell sorting system.

In summary, none of the cited references, taken alone or in combination, teaches or suggests every element of amended independent claim 12, and it would not have been obvious to combine the cited references. Thus, claim 12 should be allowed. In addition, claims 14–16 and 41, which ultimately depend from claim 12, also should be allowed for at least the same reasons as claim 12.

Dependent claims 14–16 and 41 further distinguish the claimed invention from the combined disclosures of Böhm and Miles. For example, new claim 41 recites "wherein the second transport mechanism includes a thin-film heater." Neither Böhm nor Miles, taken alone or in combination, discloses a second transport mechanism that includes a thin-film heater. Accordingly, claim 41 also should be allowed for at least this additional reason.

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III. Conclusion

Applicants submit that this application is now in condition for allowance, in view of the above amendments and remarks. Accordingly, applicants respectfully request that the Examiner issue a Notice of Allowability covering all of the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned attorney of record.

Respectfully submitted,

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CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this correspondence is being facsimile transmitted to Examiner M. Hageman, Group Art Unit 3653, Assistant Commissioner for Patents, at facsimile number (571) 273-8300 on April 24, 2007.

Christie A. Doolittle